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NITROGEN FERTILIZATION IN THE APPLE ORCHARD

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The yearly use of nitrogenous fertilizers in the commercial apple orchard has become an established practice. Fruit growers have long since recognized the fact that apples cannot be properly or profitably grown (at least under most systems of culture) without a rather liberal use of some form of nitrogenous fertilizer. To be sure, some systems of soil management in the orchard necessitate the use of larger amounts of nitrogen then others. If trees are grown in a fairly heavy grass sod we know that failure to apply some form of nitrogen results in unsatisfactory growth and yield of trees. All of you are probably familiar with this condition. It has been convincingly demonstrated that trees growing in a heavy grass sod are likely to suffer from lack of nitrogen even when considerable nitrogen is supplied to the soil. The reason for the trees' failure to obtain this nitrogen, as has been pointed out, is chiefly due to their inability to successfully compete with the grass, the result being that the grass and not the tree gets most of the nitrogen. Frequent "tearing up" of the sod (but not totally destroying it) has proven effective in dealing with such a situation. Trees receiving some cultivation are not likely to require the application of as much nitrogen as those growing in sod, the chief reasons being: (1) with cultivation, more of the organic motter of the soil is oxidized over the nitrates and is rendered available to the trees; and (2) cultivation destroys a certain amount of vegetation which naturally competes with the tree for available nitrogen.

Considerable evidence and opinion are available pro and con regarding amounts of nitrogenous fertilizers to apply per tree, season of application, and method of application (beneath the tree as contrasted with broadcasting the material). So much of the literature and so many of the recommendations by experimenters pertaining to these subjects are in such wide disagreement as to be confusing to both the fruit grower and the experiment station worker. There is still a great deal that is not known about these questions, but some of the seeming inconsistencies perhaps can be ironed out if we consider a few of the fundamental aspects of the problems.

The Nitrogen Requirement of the Apple Tree

The literature is full of references giving recommendations on the quantity of nitrogenous fertilizers to apply under varying conditions, but we hear very little about the amount of nitrogen the tree actually requires. For many plant nutrients, the amount of that nutrient present in the issues of a normal, healthy plant is a fair accurate measure of the amount of that nutrient required for satisfactory growth. If we assume that this is true with apple trees in the case of nitrogen, it would seem that a logical approach to the yearly requirement of the tree would be to determine the nitrogen

content of the various tissues (wood, leaves, shoots, and fruit) produced by a normal, healthy tree during the year. Then, by either measuring or estimating the quantity of this new growth, we are able to calculate the yearly intake of nitrogen or the amount utilized by the tree in its various growth processes. A figure thus obtained can at least serve as a basis or a partial guide in deciding upon the amount of nitrogen it is necessary to apply. A considerable number of determinations have been made at the Beltsville station recently on the nitrogen content of various tissues of the apple tree. These values, along with others obtained elsewhere, have been used in estimating the nitrogen requirement of apple trees.

In table 1 are given the estimated weight and nitrogen content of various tissues formed by a mature full-bearing apple tree under good productive conditions in the eastern States. These estimates are based on averages for productive 25-year-old trees, rather than maximum.

Table 1**.—Estimated nitrogen requirement of 25-year-old apple trees in good vigor to maintain them in that condition

Tissue	Estimated Weight Per Year—Lbs.		Approximate Nitrogen Content Percent Dry Weight	Pounds Nitrogen Permanently Removed From Soil	Removed From Soil But Ultimately Returned
	Fresh	Dry			
Fruit (exclusive of seeds)	600	100	0.23	0.23	
Seeds	---	1.8	5.5	0.10	---
Abscissing blossoms	14.0	3.0	3.0	---	---
Leaves					0.09
Midsummer	200	70.0	2.2	---	---
At leaf fall	---	60.0	1.0		0.60
Wood growth	133	80.0	0.15*	0.12	---
Bark growth	33	15.0	0.6 *	0.09	---
Root growth	130	65.0	0.45*	0.30	---
Total				0.84	0.69

*"Residual" nitrogen considered not available for translocation and reutilization.

**The data contained in this table was taken from the following article: Magness, J. R., and Regeimbal, L. O. *The nitrogen requirement of the apple.* 1938 Proceedings of Amer. Soc. Hort. Sci.

You will notice that the first item considered in table 1 is the *fruit exclusive of the seed*. The amount of nitrogen contained in the fruit (assuming an annual yield of 600 pounds or about 13 bushels) and which is permanently removed from the soil is 0.23 pounds.

Nitrogen in the seed. The percentage of nitrogen in the seed is considerably higher than in the fruit itself, and for this reason is considered separately. Most varieties average about 6 seed per fruit. Two thousand fruit (the probable number contained in 13 bushels of apples) would therefore contain 12,000 seed. This number of seed, weighing 1.8 pounds dry weight and having a nitrogen content of 5.5 percent, would contain 0.1 pound of nitrogen. This nitrogen would also be permanently removed from the orchard.

Nitrogen in blossom failing to set fruit. Normally only about 5 percent of the apple blossoms that open set fruit. A tree that matures 2,000 fruits is therefore likely to produce up to 40,000 blossoms. These blossoms, weighing about 3 pounds dry weight, will contain 0.09 pounds of nitrogen. This

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nitrogen does not disappear from the orchard as in the case of that contained in the fruits, but does represent necessary intake into the tree. These blossoms, after falling to the ground, decay and eventually the nitrogen contained in them is returned to the soil.

Nitrogen in the leaves. The total weight of leaves produced by a mature tree will vary with the growth it is making and the variety. Careful records indicate that a 25-year-old apple tree may carry as many as 200,000 leaves weighing around 200 pounds fresh weight and having a dry weight of 60 pounds at the time of leaf fall. The nitrogen content at leaf fall is about 1.0 percent, or 0.60 pounds of nitrogen for the entire 60 pounds of leaves. As is the case with the falling blossoms, this amount of nitrogen must be taken into the tree each year, but most of it may ultimately be restored to the soil when the leaf decomposes.

Nitrogen in new wood growth. The new wood formed each year consists of extensions from all growing points as well as new layers on all trunk and branch tissue. An estimate of this new wood growth has been made at about 133 pounds fresh weight or 80 pounds dry weight. This wood when newly formed contains over 1.0 percent nitrogen, but as it becomes older the nitrogen gradually moves out and is reutilized by the tree. Thus the nitrogen content of the older wood was found to be only 0.15 percent, indicating that this percentage is ultimately "trapped" and cannot be reutilized by the tree. If we assume that a tree makes 80 pounds dry weight (0.15 percent nitrogen) growth of wood yearly, it would require an intake of 0.12 pounds of nitrogen. This amount would be permanently removed from the soil.

Nitrogen in the bark. The total new weight of bark laid down each year has been estimated at 35 pounds fresh weight or 15 pounds dry weight. On the basis of 0.6 percent nitrogen which is not available for reuse, the total quantity of nitrogen tied up in the bark each year will be approximately .09

Nitrogen in the roots. The new yearly root growth of a 25-year-old apple tree has been estimated at 130 pounds fresh weight, or 65 pounds dry weight. The amount of nitrogen in roots that is trapped or unavailable for reutilization was found to be approximately 0.45 percent, which in 65 pounds of dry root tissue would total 0.29 pounds nitrogen.

The total amount of nitrogen permanently removed from the soil, according to the figures in table 1, would be 0.84 pounds. An additional amount of 0.69 pounds per year is taken in by the tree but is ultimately returned to the soil through the decay of leaves and blossoms. It should be pointed out that this 0.84 pounds of nitrogen that is taken in by the tree and permanently removed from the soil is actual nitrogen. To express it in another way, it would be equivalent to the amount of nitrogen contained in 5½ pounds of sodium nitrate. As pointed out above, the yearly intake by the tree is 0.84 pounds plus 0.69 pounds, or approximately 1.5 pounds of nitrogen, the amount contained in 9 pounds of sodium nitrate.

If less than these amounts of nitrogen are available to the tree, it will be reflected in reduced tree growth and production. For trees low in vigor much larger quantities would be necessary for the first year or two. The figures given in table 1 are based on trees receiving ample annual applications.

It should be emphasized that the figures given above apply to nitrogen intake by the tree and not to fertilizer applications. A further consideration will be given to this point following the discussion of nitrogen applications.

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Nitrate Movement in Orchard Soils in Relation to Time of Application

We often hear of conflicting opinion and results regarding the season of application of nitrogenous fertilizers. It seems probable that some of these inconsistencies can be explained by determining what happens to the nitrogen in the soil when applied at different times. In order to obtain some information on this subject, an experiment was conducted in a 30-year-old York Imperial orchard in the eastern fruit section of West Virginia. The orchard was located on a Hagerstown clay loam soil. This soil is moderately heavy in texture and very similar to many of the fruit soils in Pennsylvania. Sodium nitrate was applied 5 times throughout the year. The first fall application was made on October 15, 1937, and the second on November 23, two weeks after the leaves had fallen. Spring applications were made on April 5, 1938, three weeks prior to bloom, and May 5, shortly after petal fall. A late summer application was made on July 28, 1938. Eight pounds of sodium nitrate was applied to each tree. It was spread uniformly over the entire area beneath the spread of the branches. The areas over which the applications were made were kept free from grass and weed growth throughout the duration of the experiment. Soil samples from all treatments were taken at intervals throughout the season at 1-foot increments of depth and analyzed for nitrates in order to determine how much nitrate and over how long a period it remained in the soil at the various depths. These values were expressed in percentage of the original application (8 pounds nitrate of soda).

As most of you know, available nitrogen in the form of nitrates is soluble in water and consequently is readily leached from the soil during periods when rainfall occurs on an already saturated soil. This is very likely to be the situation during the late fall, winter, and early spring. The degree of leaching will depend mainly upon the amount of rainfall and the texture of the soil, a light-textured soil being generally more subject to leaching than a soil heavier in texture.

Let us now consider the results of this experiment. Approximately 7 inches of rain coming within a month after the October 15 application was sufficient to carry 44 percent of the 8 pounds of nitrate that was applied October 15, into the second foot of soil. In most soils the roots of apple trees are in the greatest abundance in the first foot, decreasing markedly in the second foot. While nitrate may be absorbed from the second foot of soil by apple roots, it is believed that the relatively fewer roots present at this depth, as compared with the first foot, greatly limits the absorption of nutrients at this level.

On April 20, 1938, only 8 percent of the nitrate remained available in the first foot of soil (October 15 application), while 34 and 44 percent was present in the second and third feet respectively. On this same date the November 23 application had 64 percent of the nitrates remaining in the first foot, 20 percent in the second foot, and only 2 percent in the third foot.

Thus there was a striking contrast between the two fall applications in the amount of nitrogen present on April 20 at the various depths. What seems to be the reason for this wide difference between two fall applications made only a little over one month apart? Samples of roots and twigs of trees of the two lots showed no difference in nitrogen content. In fact, analyses showed that very little nitrate had been absorbed by these trees during the late fall and winter. The explanation for the difference seems to lie in the rainfall records. A total of 15 inches of precipitation occurred between October 15 1937, and April 20, 1938, while only 7½ inches occurred between

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November 23, 1937, and April 20, 1938. In other words, the additional 7 to 8 inches of rain to which the October 15 application was subjected was sufficient to leach 44 percent of the nitrate below the second foot of soil. Due to the relatively few absorbing roots below 2 feet, it is believed that most of this nitrate was lost to the tree.

From these figures I think you can readly see one reason, at least, why conflicting results have been obtained with fall applications. The variability between seasons, particularly rainfall, has much to do with the nitrate movement in the soil and nitrate availability to the tree. Shortly before and during bloom the demand for nitrogen by the trees is probably greater than at any other time. In this experiment, 2 weeks prior to bloom in the case of the November 23 application, the trees had 64 percent of the applied nitrogen available in the first foot of soil; in another case (October 15 application) only 2 percent was available in the first foot. It should be pointed out that if the experiment had been conducted some other year the results might have been different, depending upon the rainfall. It is quite possible that in some years there would be no difference between the two applications if no rainfall occurrd between the dates of the first and second fall applications.

The figures for the spring applications (April 5 and May 5, 1938, show very little leaching below the first foot of soil, even though the rainfall for spring and summer averaged over 3 inches per month. Removal of water from the soil by evaporation and transpiration was apparently sufficient to equal the rainfall and thus prevent downward movement of nitrates. There existed throughout most of the spring and summer a high nitrate content in the first foot of soil in both spring applications. The disappearance of nitrates from the first foot of soil during the spring and summer can be accounted for by tree absorption and "soil fixation." In the latter case, nitrates are tied up by soil organisms and are rendered temporarily unavailable to the tree. This nitrogen adds to the nitrogen reserve of the soil and is not to be considered as lost.

The results of this experiment with soil nitrate movement indicate that, even with fairly heavy soils, downward movement of nitrates is quite rapid; in fact, if as much as 15 inches of precipitation occurs during the dormant season following a fall application of nitrate, much of the nitrate applied will be below the depth of effective root concentration when growth starts the following spring.

Absorption of Nitrogen by the Tree

Considerable difference of opinion exists regarding the amount of nitrogen taken in by the tree during the dormant period. This question seems far from being settled. In some cases, apparently some nitrogen is absorbed during this period, or at least taken into the roots. In the experiment described above, no significant increase in nitrogen content of roots and twigs occurred as a result of fall applications before the following March. Our results indicate that nitrogen is taken up most rapidly and most actively by the tree when there is a foliage system on the tree. It would seem, therefore, that if fall applications are made, the material should be applied in late summer or early fall, two months prior to defoliation. Because of greater tree intake during this period as compared with late fall, loss from leaching should be considerably less. If a "split" application is desired, a part of the nitrogen could be applied in early fall and the remainder put on a week or so prior to bloom. From the results described above, it would seem that if only

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one application is made the greater benefit with the minimum of leaching would be derived (at least in the case of sodium nitrate) if applied in the spring at a time when 4 to 5 inches of rain prior to bloom could normally be expected.

Summary

In the earlier part of this paper the nitrogen requirement of the apple tree was discussed. The yearly nitrogen intake of a mature apple tree was calculated at approximately 1½ pounds of actual nitrogen. It should be emphasized that this amount is necessary for the tree itself; considerable quantities are also necessary for the sod or cover crop. To be sure, it is not necessary to furnish all of the nitrogen required by both tree and cover crop from fertilizer bag. A certain amount of available nitrogen is produced through the decomposition of organic matter in the soil. The amount made available in this manner will vary depending upon the soil and the system of soil management. However, under most conditions a large portion of the nitrogen needed must be purchased by the grower in the form of nitrogenous fertilizers. We believe that consideration as to (1) time of application in relation to rainfall, and (2) season of greatest nitrate absorption by the tree will increase the dividends from fertilizer expenditures.
pounds.

WAYS AND MEANS OF REDUCING THE QUANTITY OF NON-PROFIT CULL APPLES

H. W. PRETTYMAN, Extension Horticulturist, Marketing, Inwood, W. Va.

(Continued from last month)

Some of the factors entering into damage by hauling were (1) boxes were sometimes over-filled, (2) orchard roads were rough and drivers failed to use good judgment and care to avoid the rough spots, (3) boxes were not always stacked squarely on truck or platform. When a box is over-filled, it means not only severely cutting or bruising an apple or two on the top, but the pressure on these few apples is passed down through the box, and quite often we found the apples bruised all the way down through the box to the bottom. A good foreman will overcome this source of trouble by working with his pickers and loaders and by showing them exactly how the boxes should be filled. I think it will help a lot in getting your fruit out in good condition to spend a few hours whenever possible in going through the orchard and smoothing up a few of the rough spots. Then at harvest time caution your driver about the damage he does to his load when he gets up too much speed and hits a rough spot or a stone and gives the entire load a severe jolt. We use mostly a standard orchard lug box for hauling from the orchard to the packing house. This box, as you know, is built to hold a bushel when it is filled to the top of the sides and there is about one inch on each end that stands up as a lug for the next box to rest on. If care is used in stacking, this works out fine, but when the boxes get old and lose a few lugs, or the driver gets tired and fails to use care in stacking them up squarely, you will find that every now and then, the end of one box will drop off the lug and slip down into the apples in the box below. This doesn't seem at the time to amount to much, but if it is allowed to get by without attention you soon will find that more and more boxes are getting out of line and it will result in plenty of trouble so far as your bruising problems are concerned.

Fast handling on roller conveyors is another potential source of damage by bruising. Next time you see some loose fruit being handled in this way, watch what happens when the boxes are swung onto the conveyor with a jerk and given a slam into those boxes which the stacker may not have gotten out of the way. Every apple in two or more boxes will give a bounce and when this happens, especially to such varieties as Grimes, Golden Delicious and Stayman an unbelieveable number of slight bruises are added to all the rest that accumulate so rapidly from the time the fruit leaves the tree. So watch carefully for this apparently minor source of trouble, for our experience has been that it is not the occasionally badly cut and bruised apple that brings such a protest from the man who buys our apples, but rather this multiplicity of many and miscellaneous bruises that so badly mars the general appearance of our eastern packed apples.

Bruises Caused by Machines

In order to determine the amount of bruising done by each unit of a grader, it necessitates the slow procedure of running a given sample through each unit and checking the sample before it passes on to the next unit. Various attempts were made to do this by random sampling at different points on the grader, but the results varied so widely that they gave but little indication of what actually happens as the fruit is passed from one unit to another. In one instance, however, a bruise-free sample of Grimes was run over a grader with an underflood brush-type washer, a "kicker wheel" sizer and continuous bin with distributing belts, and as the apples passed each of these units, the machine was stopped and a complete check made of the resultant bruises.

The results of this work are shown in Table 2.

TABLE 2—Bruises Caused by Various Units of Our Apple Grader:

Degree of Bruise	At Start		Thru Washer		Thru Sizer		In Bins	
	Count	%	Count	%	Count	%	Count	%
None	215	100	91	42	63	29	46	21
Slight	-----	-----	119	56	123	57	105	49
Serious	-----	-----	5	2	29	14	64	30
Total	215	100	215	100	215	100	215	100

In this test it was found that 58 per cent of the apples were bruised to some extent by the washing unit; the sizer added another 13 per cent to what the washer had done, and by the time the fruit was in the bins and ready to be run into the package, the total amount of bruising came to 79 per cent of an originally 100 per cent bruise-free sample. This check was made in one of our better packing houses and, while much variation will be found in the amount of damage done by different machines, yet the fact remains that all of them injure the fruit to some extent and every possible precaution should be taken to eliminate mechanical injury and to educate our packing crews to handle the fruit more carefully at all times.

Bruises in the Container

The Federal Grades Regulations state that all No. 1 apples shall be free from bruises except "those incident to proper handling and packing". Mr. M. E. Smith of the Fruit and Vegetable Standardization Division of the Bureau of Agricultural Economics conducted a very general survey during the season 1937 to determine just how much bruising damage was incident to proper handling and packing. The results of this work have not been

made known, but in order that we might know something of the extent to which bruising is found in the package, before it leaves the packing house, counts were made on a number of varieties, and it was found that the average total bruises in baskets, ready for shipment, but before loaded on cars was 57 per cent. Grimes was highest with 72 per cent and York lowest with 28 per cent. The serious damage ranged from 14 per cent in York to 57 per cent in Grimes and Golden Delicious. Most of the serious bruising found in the baskets was due to numerous slight bruises and to cuts, stem punctures and heavy bruises resulting from pressure applied in lidding and stacking. More care on the part of runners to keep the fruit well settled as the basket is being filled and close supervision by the foreman of the net contents of the package should reduce in some measure, the injury done by over-pressing during the lidding process. In many instances much of the injury by rough handling can be avoided by providing the proper kind of trucks or conveyor systems for taking it away from the lidders, and by directing the warehousemen to exercise more care in stacking and loading. Likewise the use of flimsy containers, be they boxes or baskets, should be avoided. Only the most rigid types should be used if you want your fruit to reach the retailer with anything like an attractive appearance. Some follow-up was made during the 1937-38 marketing season on the condition of apples after htey had gone through storage, and were offered for sale on the Morgantown, W. Va. market. In this study we examined several different kind of packages such as export tubs, wirebound boxes,1 1-5 boxes (jumble-packed) and standard pack Northwestern boxes.

The results of these studies are shown in Table 3.

Degree of Bruise	1 1-5 Box Winch, Va. Blk. Twigs		Exp. Tubs Nearby Red Del.		Exp. Tubs Winch, Va. Gold. Del.		Wire B. Box Frederick, Md. Stayman		N. W. Box Wash. Red Del.		All Packages All Sources	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
None	56	8	185	28	46	5	13	2	59	13	299	10
Slight	171	23	324	48	217	26	174	29	147	32	886	31
Serious	509	69	166	24	573	69	423	69	254	55	1671	59
Total	736	100	675	100	836	100	610	100	460	100	2856	100
Total Bruises	-----	92	-----	72	-----	95	-----	98	-----	87	-----	89

It is interesting to note in this study that the apple shipped into West Virginia from the State of Washington showed less total bruise and less bruise of a serious nature than all of the samples checked from the Shenandoah producing area, and that the amount of serious damage was identical (69%) in the wirebound, 1 1-5 bushel box, and export tubs.

During the past season, we continued our study of bruising, but confined it almost exclusively to determining the effects of various net weights on the problem of bruises in the package. As all of you know, there is always a difference of opinion between the man who packs the fruit and the one who buys it as to how much fruit there should be in the basket. Accordingly, we set out to learn just how much damage was done to the apples when the pack-

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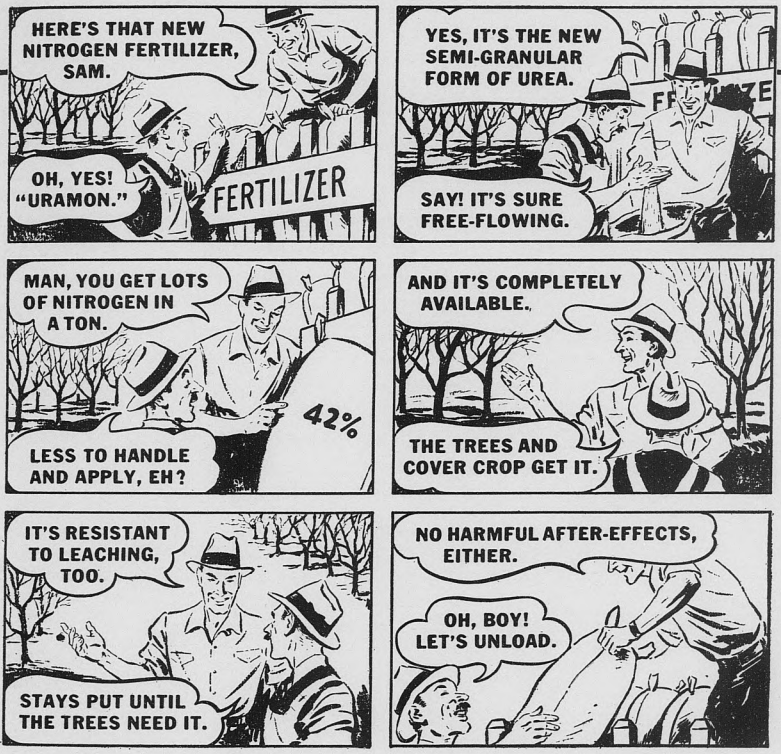
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ages were heaped up as some buyers insist upon having them. To get at the problem, we ran several series of test baskets with weights ranging from 43½ lbs. to 48 lbs. net, and after these packages were lidded and set aside in the shipping room, they were carefully inspected for both total bruises and for bruises that apparently were due to the pressure of one apple upon another or to contact with the lid or package proper. The results we secured from this study would indicate that varieties like Grimes, Stayman and Golden Delicious should be packed with not more than 44½ to 45½ pounds per bushel. As a matter of fact, however, the commercial shipments from the Inwood Plant were packed, Grimes 44½ pounds, Stayman 46 pounds and Golden Delicious 45 pounds. When packed, these packages presented a full, rounded appearance, and most of the U. S. Certificates issued against them read "pack tight" or "pack fairly tight", and it was evident that any more apples would have resulted in much damage from bruising. However, there was considerable complaint from the receivers of this fruit that the packages were "slack" upon arrival, and several cars that were placed in cold storage had to be "plugged" before shipment early in December.

Some of the details of the study on net weights are shown in TABLE 4.

TABLE 4—Number of Apples Per Bushel with Bruises of a Serious Nature Caused by Contact with the Container or Other Apples

		Net Weight Per Bushel—Pounds									
Winesaps											
Variety		43½	44	44½	45	45½	46	46½	47	47¼	48
No. 1-2½ in. up		7	7	8	3	3	12	10	20	20	24
		7	9	7	10	5	8	19	20	23	24
	Total	14	16	15	13	8	20	38	40	43	48
	Average	7	8	7½	6½	4	10	19	20	22	24
Red Delicious											
2¾ up	Total	11	16	15	15	14	11	14	38	41	44
	Average	11	16	15	15	14	11	14	38	41	44
Grimes											
2½-2¾		16	18	32	41	38	42	45	55	68	73
		18	13	23	25	26	30	21	---	---	---
	Total	34	31	45	66	64	72	66	55	68	73
	Average	17	15½	22½	33	32	36	33	55	68	73
Golden Delicious											
2½ up		15	23	24	20	27	31	41	28	39	49
		22	30	31	26	40	23	48	45	67	74
		24	12	31	29	25	31	40	31	62	33
		16	21	29	23	20	34	23	41	43	39
		26	23	22	26	30	29	26	36	34	45
		21	23	17	23	24	34	35	37	44	62
	Total	124	152	144	147	166	182	203	218	289	302
	Average	21	25	24	25	28	30	34	36	48	50
York											
3" up		---	---	5	6	7	10	12	16	17	16
		---	---	3	9	6	6	6	19	21	21
		2	2	4	3	4	5	10	21	15	28
		6	6	9	6	7	8	19	21	18	25
	Total	8	8	21	24	24	29	47	77	71	90
	Average	4	4	5	6	6	7	12	19	18	22½
Staymans											
3" up		8	12	11	18	15	26	30	31	39	33
		18	16	18	14	22	27	27	26	28	26
	Total	26	28	29	32	37	53	57	57	67	59
	Average	13	14	14½	16	18½	26½	28½	28½	33½	29½
Average of All		14½	16	15	17	18	21	25	28	34	36

Apparently the cause for much of this trouble comes from our present method of packing. When the basket is substituted for the metal tub, the paper lining has a tendency to keep the fruit from settling properly in the basket. Then, when it makes the journey to market or storage, the jolting in transit tends to settle it and it becomes "slack". As a check against this, we propose to continue the study and to compare ordinary export tubs with such packs as E. Z. Way which may be packed without the use of the metal forms.

Conclusions:

1. Reduce the average age of trees by:
   (a) Replanting on better sites and soils.
   (b) Removing non-profitable plantings on poor site and soils.
2. Keep trees growing vigorously. Prune out weak wood. Remove defective fruit in thinning process.
3. Follow systematic spray program.
4. Watch pickers individually—they bruise from 10 to 50 per cent of all the apples.
5. Hauling adds 10% to bruises. Improve orchard roads. Use good crates and exercise more care in filling and hauling them.
6. Use sponge rubber as padding about the grader. Eliminate excessive drops; reduce size and slope of packing bins; time feeding to the rate of packing; avoid over-running bins.
7. To reduce bruising in the package; pack tightly, but do not over-fill packages; use care in handling filled containers. Don't walk on packed baskets.
8. Use good containers. Cheap, flimsy baskets spread and distort the face and become slack.
9. Load cars and trucks with care; avoid squeezing packages.
10. Urge storage companies to use shelves or other forms of support when stacking in high-ceiling rooms.

Have you read the advertisements?

COLD STORAGE HOLDINGS

The U. S. Bureau of Agricultural Economics reports 15,008,000 bushels of apples in storage on March 1. During the month 5,701,000 bushels were withdrawn from storage. Holdings on March 1, 1938 were 19,540,000 bushels. Of the present holdings, there is almost an equal amount of Eastern bushels, and Western boxes, roughly a little over seven million bushels of each.

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PUSHING APPLE SALES

Baltimore Apple Week was staged in Baltimore February 15 to 25. It was sponsored jointly by Appalachian Apples, Inc., and Baltimore Fruit and Produce Association. There were 34 stores in window display competition, and some really artistic displays of apples were placed in the various store windows. Twelve prizes were awarded. First prize was $25.00; second $10.00; and there were 10 prizes of $5.00 each. Apple sales increased very markedly, and some very good Eastern apples were displayed.

"Goodness", exclaimed the old lady, "isn't that boy swearing terribly?"

"I'd say so", replied her kid nephew, "His grammer is bad and he has no expression."

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D-X is now a combined pyrethrum and rotenone spray, for the first time within the means of the commercial fruit grower.

These toxic elements are impregnated in a patented base giving greatest penetration, a process which is the result of years of research by some of the foremost entomologists of the country. This process has also reduced the cost of this material so that D-X is the lowest cost contact spray available today.

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A New York grower writes:
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